Measuring what Matters in the Great Barrier Reef

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Abstract

The natural environment is integral to the lives of people and central to human culture. The culture within an ecosystem influences how ecosystem benefits or services are valued. Whilst often acknowledged, ~~this~~ the non-utilitarian value of ecosystems is difficult to capture and thus is rarely incorporated into environmental strategic planning. We build on the Ecosystem Services conceptualization of human-environment relationships to propose an approach that decision-makers can adopt to systematically consider cultural values across a range of stakeholder groups and their cultures when deciding the future of contested landscapes. The importance of identity, pride, place, aesthetics, biodiversity, lifestyle, scientific ~~heritage~~ value and ~~agency~~ the maintenance of wellbeing are assessed within the Great Barrier Reef region by 8,300 indigenous and non-indigenous local residents, Australians, international and domestic tourists, tourism operators, and commercial fishers. We highlight areas of consensus and differentiation, and recognise that cultural values matter to people and could be leveraged to secure the future of iconic ecosystems such as the Great Barrier Reef.

Introduction

Regardless of their importance in our lives, the real value of ~~natural places~~ecosystems is often vastly underestimated (Costanza *et al.* 1997). They are typically ~~represented~~ valued for ~~by~~ their economic and environmental ~~values~~benefits, and their social values are left unconceded. Yet, natural places are critical to the psychological maintenance of contemporary society. They are more than a mere substratum that provides resources and a setting within which systems of activities take place. People assign "cognitive and imaginative overlays" onto it, they use it as a "bedrock for perception and inspiration", and they intricately authenticate feelings of belonging, meanings of self, lifestyle, and community to it, all with special meanings (Willis 2014 p187). In short, ecosystems provide constantly evolving ~~cultural~~ opportunities ~~through~~ for spiritual and intellectual engagements, economic well-being, and day-to-day meaning (Adger *et al.* 2012, Chan *et al.* 2012, Fish 2011~~7~~). Accordingly, whilst ecosystems indeed contribute to making human life possible, they also contribute to making life worth living (Costanza *et al.* 1997).

The culture, or traditions, customs and ways of life, that is created around a natural environment can sometimes be so integral to the lives of people that any disassociation from the environment can render people disoriented and disempowered (Bonaiuto *et al.* 1996, Fisher and Brown 2014). For example, when a resource-user such as a fisher, farmer or forester is suddenly faced with the prospect that they are no longer viable in their resource-based occupation, they not only lose a means of earning an income, they lose an important part of their identity (~~Devine-Wright 2009,~~ Marshall et al. 2012, Tidball 2012). Loss of identity can, in turn, drive economic, psychological and social impacts; with severe impacts in many situations. Turner et al. (2008) describe such impacts in terms of losses and identify cultural/lifestyle losses, loss of identity, health loses, loss of self-determination and influence, emotional and psychological losses, loss of order in the world, knowledge losses, and indirect economic losses and lost opportunities. They refer to the case of First Nations communities in western North America where individuals and communities have experienced a significant decline in overall resilience due to a lack of inclusive approaches to resource management that do not recognise the legitimacy of cultural values and traditional knowledge in environmental decision making and policy. Such "invisible impacts" are not widely

recognized or accounted for in environmental decision making: they are often indirect or cumulative ~~and can result from a complex series of events, decisions or policy changes~~ (Turner *et al.* 2008). Ignoring invisible losses ~~cultural matters,~~ or the intangible benefits that people derive from a natural resource ~~such as loss of identity,~~ can undermine the success of environmental policy initiatives (Devine-Wright 2009) ~~in environmental management by increasing controversy and decreasing the efficiency in producing workable outcomes, and risks serious invisible impacts. Culture resonates as a key entry point for public engagement in environmental issues. Cultural aspects have been used by environmental managers as a political tool for mobilizing collective action, coalescing social support and creating conditions for radical change (Oleson *et al.* 2015).~~ However, ~~e~~Evidence is ~~a~~ rapidly accumulating to suggest that the incorporation of what people culturally value about special places – cultural values - can assist in the design of policies that not only protect a natural resource but also trigger less conflict, inspire higher compliance, and minimise the costs associated with protecting a resource (Prober *et al.* 2011).

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Cultural values resonate as a key entry point for public engagement in environmental issues. Cultural values have been used by environmental managers as a political tool for mobilizing collective action, coalescing social support and creating conditions for radical change (Oleson *et al.* 2015). Cultural values are what people treasure within ecosystems. How people value the benefits or services provided by ecosystems is determined by their traditions, customs and ways of life (culture), and thus cultural values can vary considerably between stakeholder groups (Kittinger et al. 2014). ~~These benefits effectively underpin the cultural values or relational values that people hold around ecosystems. These~~ C~~c~~ultural values include aspects such as belonging, attachment to place, heritage, rootedness, spirituality, tranquillity, inspiration, escape, discovery, knowledge, health, dexterity, and judgement as well as aesthetics, recreational opportunities, spiritual growth, community development, and education (Turner *et al.* 2008, Fish *et al.* 2011, Chan *et al.* 2012a). However, in a recent review, Fish *et al.* (2011) reported that only around 50 ecosystem service assessments have formally considered cultural ~~services~~values, suggesting that ecosystem service frameworks are not being used to their full potential (Daniel *et al.* 2012). Yet, environmental managers are increasingly seeking guidance and strategies for integrated approaches that result in the sustainability of ecosystems and the social systems dependent on them (Fish *et al.* 2015, Satterfield *et al.* 2013, Satz *et al.* 2013). It is to this call that we respond.

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~~Contrasting values is particularly pertinent given that environmental managers are stewards of special areas on behalf of a diverse constituency; understanding the constituency and their relationship with the ecosystem is critical to successful environmental management.~~ Our purpose is, in part, to position cultural values – or how people value natural resources, ~~e~~ as a core concern in environmental management and planning. ~~Culture resonates as a key entry point for public engagement in environmental issues. Cultural aspects have been used by environmental managers as a political tool for mobilizing collective action, coalescing social support and creating conditions~~ [illegible] perspectives, around cultural ecosystem services or the "non-material benefits people obtain from ecosystems" (Fish 2011) and in part from knowledge of the importance of culture in adapting to environmental change (Adger et al. 2013), and the importance of culture as an influence on cultural values. We propose an approach to conceptualise and operationalise how people value the cultural benefits ~~associated~~ from a ~~with~~ natural resources. Our intention is to assist ~~so that~~ decision-makers ~~can~~ to more transparently consider and contrast the cultural values held by ~~the range of~~ different stakeholder groups. ~~Contrasting values is particularly pertinent~~ Gg iven that environmental managers are stewards of

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special area on behalf of a diverse constituency, understanding the diversity in ecosystem values constituency and their relationship with the ecosystem is critical to successful environmental management. We do not comprehensively document cultural values in this study, but rather select those likely to inspire greater consideration of cultural values more generally in resource management.

We use the example of the Great Barrier Reef in Australia, a World Heritage Area and a region currently undergoing significant environmental, social, and economic change, to conceptualise and test an approach to support environmental managers to better consider the cultural values associated with a resource. Through a workshop of disciplinary and interdisciplinary experts (predominately social scientists and Ecosystem Services scientists) and by reviewing existing literature we identified the following key cultural values as potentially of ~~key~~ high relevance to people's relationship with the Great Barrier Reef: identity, pride in ~~World Heritage Area~~resource status, attachment to place, aesthetic appeal, appreciation of biodiversity, lifestyle, scientific ~~heritage~~value, and ~~agency~~ wellbeing as potentially important cultural values (Table 1). We then operationalized these concepts by surveying, respondents about their relative importance. To determine how these key cultural values differ among stakeholder groups, we quantitatively compared the relative rankings of each type of cultural value among seven groups: domestic tourists, international tourists, local residents, indigenous residents, non-local Australian residents, commercial fishers, and tourism operators.

<*insert* Table 1 *around here* >

The Great Barrier Reef Marine Park

The Great Barrier Reef GBR is the largest and most diverse coral reef ecosystem on Earth, spanning 2,300km along the east coast of Queensland, Australia. The GBR was listed as a Marine Park in 1975 in response to a direct threat from oil drilling, and was inscribed on the World Heritage List in 1981 in recognition of its "outstanding universal values". This period is characterised as a time when public affinity for the GBR drove decision makers to protect the ecological values of the region, culminating in the establishment of a parliamentary Act, *the Great Barrier Reef Marine Park Act 1975*, to provide legislative protection of core environmental values. Whilst the Great Barrier Reef is one of the most inspiring landscapes within Australia for Australians (Goldberg *et al.* 2016) recent ecological monitoring suggests that the ecosystem has suffered a 50% decline of hard coral cover since 1975 as a combined result of poor water quality, cyclones, crown-of-thorn starfish outbreaks, and a series of coral bleaching events (De'ath *et al.* 2012). The cultural impact that these changes are having are effectively unknown, and coastal development proposals continue to be a contentious aspect of the management of the GBR. Within this context, cultural aspects have become particularly important to consider.

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Methods

Data for this work was obtained from the baseline data of the Social and Economic Long Term Monitoring for the GBR SELTMP and reinterpreted for the purposes of the current study. The SELTMP was designed to monitor current conditions and trends of the human dimension of the GBR

system. Marshall *et al.* (2016) provide details of the SELTMP, and data can be accessed at: http://seltmp.eatlas.org.au/seltmp.

Survey design and administration

Five surveys based on the same template that differed only contextually were designed that targeted i) Australians, ii) coastal residents, iii) domestic and international tourists, iv) tourism operators, and v) commercial fishers. Respondents were asked to agree or disagree with a statement about each cultural value on a ten-point scale (Table 1).

Surveys were designed as i) online surveys: to reach a representative sample of Australians 'Nationals', ii) face-to-face surveys: to randomly select coastal residents and tourists within the region, and iii) telephone surveys: to target as many commercial fishers and marine tourism operators as possible. Indigenous residents were invited to identify themselves as an Indigenous Australian or Torres Strait Islander if they wished.

The online survey was conducted in March and September 2013 using an online research panel provided by an external marketing company with access to a geographically and demographically representative sample of Australians who were prepared to complete surveys in exchance for online credit points that could be converted into gifts or goods. A total of 2,002 responses were collected and analysed. The sample was representative of the Australian population with regard to location, age and gender, and ~~a total of 2,002 responses were collected and analysed.~~ The sample ranged in age from 16 to 64. The March/April sample was 50:50 male:female and the September survey was 48:52. Most respondents were residents of major cities, consistent with the Australian demographic.

Face-to-face surveys were administered to locals and tourists in 14 coastal communities alongside the GBR between June and August 2013. We employed and trained 35 casual staff and deployed them to public places such as parks, shopping centres, market places, airports, marinas, sporting areas, information centres, museums, jetties, caravan parks and lookouts. We used a mix of "random sampling" and "quota sampling" in which we achieved a sample or survey participants representative of the Australian public with regard to age, gender, ethnic background and occupation. A limitation of our sampling was a bias towards English speaking people. Residents were defined as people who lived within the Reef catchment (east of the Great Dividing Range, from Bundaberg to Cape York). Australian aboriginals and Torres Strait Islanders were asked to self-identify. Of all the people that were approached, 59% accepted to complete the survey. A total of 3,181 residents and 2,788 tourists were included in the final analysis. Residents surveyed ranged in age from 16 to 91, and were 44 years of age on average (standard error=.29). The sample was 50:50 male:female, and 78% were born in Australia. Household income was spread from low to high, and reflected population statistics for the region (abs.gov.au). Residents had been living within the region for a mean of 20 years (se=.32).

Tourism operators were interviewed by t~~T~~elephone after receiving an invitation to participate in the study in the mail. Due to ethical and commercial-in-confidence reasons, we built our own contacts database of tourism operators using a comprehensive web-search and identified 213 tourism businesses that appeared to be in current operation within the Marine Park. ~~surveys of tourism operators were conducted where~~O~~, o~~f the 213 tourism operators, 57 were unresponsive, 34 declined, and 122 accepted to participate in the research. ~~Our~~ The response rate of those that could be contacted was 78~~83~~%. Incomplete surveys were not included, resulting in a final sample of 119 surveys ~~included in the analysis~~. The sample of 119 tourism operators consisted of 77 business owner-managers, 39 managers and three other senior staff who could speak on behalf of their company.

Commercial fishers were also interviewed by t~~T~~elephone after receiving an invitation in the mail. Based on licenses issued and information on fishing activity (DAFF, unpublished data, 2013), we estimated that there were 611 commercial fishers in possession of at least one license to operate in the Marine Park. Using our own contacts database and publically available information, surveys of commercial fishers were conducted where, of the 276 fishers on our list, 210 agreed to be surveyed, representing an estimated 34% of all active ~~fishers~~ permits within the GBR region. Our response rate was 76%. —The sample of commercial fishers had an average age of 55, 93% were male, 85% were married or with a partner, 56% had high school education or less, and 81% had operated in the GBR in the previous 12 months. Surveys included all fishing types, broadly grouped to Line, Trawl, Net, Pot and Harvest fisheries, and 60% accessed only one broad fishery type. Most (92%) respondents were owner-operators, and most (67%) operated one main vessel (and hence one licence).

Data analysis

Means for each user group were represented on an eight-axis spider plot, where the strength of each cultural dimension could be contrasted within and between each user group. An ANOVA was conducted to identify if there were statistically significant differences between stakeholder groups, and a Tukey post-hoc test was conducted to identify which relationships between specific groups were significant. Results were colour coded for ease of interpretation and are presented in Figure 2. Some indicators could not be assessed for all stakeholder groups.

Survey costs

Given that we are interested in inspiring natural resource managers to consider assessing cultural values within their jurisdiction, we provide indicative operational information to assist with the decision-making process. In this study, the cost of online panel data via an external provider was around $1,600 (AUS) per question per 1,000 responses (total of $22,400 AUS). The cost of doing ~6,000 face-to-face surveys and ~330 telephone calls was about $50 per survey (total of $300,000). Most of the expense was directed towards paying interviewers $35 per hour, deemed necessary to attract excellent quality staff. The extra was spent on driving staff to various locations, purchasing 30 mini-ipads (which we on-sold at the end of the project at a discount), and ensuring that the interview staff were well supplied with drinks and snacks. Accommodation and travel was required for some interview staff, and local staff were sourced where possible. These costs were in addition to the core team of four researchers that were employed at 0.3FTE for the year. We were able to collect the data within 2 months, and calculate that an average of 1-2 surveys were completed per hour per interviewer. Surveys were only conducted during daylight hours.

Results

Shared values indicate to managers what to protect for the benefit of all. All eight cultural dimensions that we identified as being potentially important were very much valued by at least some stakeholder groups. There was widespread agreement among stakeholder groups that biodiversity, aesthetic, and lifestyle values were important, suggesting that cultural values may be a basis for stronger consensus on resource value across all stakeholders (Figure 2). We highlight that whilst dimensions such as lifestyle were important to all, lifestyle preferences were likely to differ between stakeholder groups. We also note that whilst some stakeholder groups shared values such

as pride in WHA status, there was seemingly little correlation with other dimensions such as identity, which was shared to a lesser extent.

Highly rated values indicate to managers what to prioritise for each stakeholder group. The most highly rated values across all stakeholder groups included reef aesthetics (mean=9.03, se=.019), biodiversity (mean=9.03, se=.019) and pride in the World Heritage Area status (mean=8.68, se=.021). Coastal residents, domestic and international tourists, and indigenous residents rated their pride in World Heritage Area WHA status, aesthetics and biodiversity most highly. Tourism operators and commercial fishers rated biodiversity, aesthetics and place attachment most highly. Australians rated their pride in WHA status (mean=8.23, se=.04) and their GBR identity (mean=7.39, se=.05) most highly. These results suggest that aesthetic values as well as pride in WHA status were most important for most stakeholder groups.

Divergent values indicate to managers what to protect for the benefit of particular stakeholder groups. We found revealing divergence among stakeholder groups regarding the importance of some key cultural values including attachment to place, pride in World Heritage Area WHA status, agency, and identity (Figures 1 and 2). Place attachment, as assessed by the statement, "I live here because of the GBR" was rated significantly higher, for example, by commercial fishers (mean=6.59, se=.24). In contrast, fishers did not rate scientific heritage (mean=7.33, se=.17) or pride in the World Heritage Area status (mean=7.03, se=.22) as highly as indigenous residents (mean=8.65, se=.15), or local residents (mean=8.47, se=.03), highlighting also how cultural relationships can be equally strong within the region, but for different reasons. We also highlight how some values were divergent because of factors such as proximity to the GBR. For example, we see that identity around the GBR was generally strongest within people that lived the closest to the GBR (tour operators and indigenous residents) and weakest within people that were most distant from it (domestic tourists and international tourists). Importantly, however, Australians had a higher identity around the GBR than local residents suggesting that factors other than proximity to GBR are also having effect (Marshall et al. 2016).

Conclusions

This study positions cultural values ~~e~~ as a core concern in environmental management through offering a demonstrable approach to assess the importance of ~~eight~~ cultural values across key stakeholder groups (Chan *et al*. 2016). We have selected eight cultural values amongst potentially many others, and provided new knowledge of which are highly rated, shared, and divergent. This knowledge can assist managers to understand (respectively) the cultural value of the natural resource, cultural priorities, what to protect for the benefit of all, and what to protect for whom. Divergences and convergences within the data suggest that cultural values are unrelated constructs. For example, stakeholders can share cultural values such as pride in WHA status, but not share similar levels of identity around the Great Barrier Reef (GBR). Within group divergences are also likely to be important within the region, and future research could focus on the extent to which cultural values are shared within each stakeholder group.

~~The utilitarian values people hold for ecosystems are widely acknowledged and increasingly incorporated into decision-making processes, however the non-utilitarian aspects that are described in this study have received much less attention, despite mounting signs of their substantial importance. Partly, environmental managers and planners have lacked the tools and support to~~

~~quantify and qualify the cultural significance of ecosystems.~~

economic and ecological factors against cultural values for the purposes of assisting environmental managers to more clearly see what matters most (Redman *et al.* 2004). In this way, we see that leveraging cultural values can build wider public support for ecosystem protection, and balance short-term competing economic demands with longer term cultural matters. Monitoring how rapidly culture is evolving, in what direction, and to what extent it is being influenced by a range of external factors, such as advertising and social media will also help environmental managers understand the extent to which culture is dynamic, and the effectiveness of their work (Marshall *et al.* 2016). Whilst our research elicited some important observations, our approach does not provide the richness and depth to interpret the full complexity of cultural relationships that exist within the GBR, and qualitative data that complements the quantitative approach will provide much needed insight.

In sum, t~~T~~he utilitarian values people hold for ecosystems are widely acknowledged and increasingly incorporated into decision-making processes, however the non-utilitarian aspects that are described in this study have received much less attention, despite mounting signs of their substantial importance. Partly, environmental managers and planners have lacked the tools and support to quantify and qualify the cultural significance of ecosystems. It is our hope that the proposed approach will inspire the development of such needs.

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Figures and Tables

Table 1. A selection of c~~C~~ultural values ~~of ecosystems expected to be~~ potentially relevant within ~~to~~ the Great Barrier Reef region and tested within this study using the statements listed~~. Statements used to indicate the level of cultural connection with the Great Barrier Reef are also listed~~. Participants were asked to rate how strongly they agreed with each statement on a scale of 1 to 10, where 1= absolutely did not agree and 10= very, very much agreed.

Cultural Values	Description
Identity	The feeling of belonging to a place or social group with its own distinct culture and common social values and beliefs (Adger et al. 2011, Marshall et al. 2012) Survey statement: The GBR is part of my identity
Pride in resource status	Refers to a satisfied sense of attachment towards a place or its status such as World Heritage Area status. It can be linked to a signal of high social status (Marshall et al. 2016) Survey statement: I feel proud that the GBR is a World Heritage Area
Place importance / Attachment to place	The emotional and physical bond between person and place which is influenced by experiences, emotions, memories and interpretations. It often provides a reason for people to live where they live (Adger et al. 2013, Devine-Wright 2009)~~.~~ Survey statement: I live here because of the GBR
Aesthetic appreciation	Describes the aesthetic value that an individual attributes to aspects of an ecosystem. Aesthetic responses are linked to both the characteristics

	of an environment and culturally or personally derived preferences (MA 2005, Pike *et al*. 2011, Klain *et al.* 2014) Survey statement: The aesthetic beauty of the GBR is outstanding
Appreciation of biodiversity	Describes how people are emotionally inspired by biodiversity and other measures of ecosystem integrity at a particular place (Marshall et al. 2016) Survey statement: I value the GBR because it supports a variety of life, such as fish and corals
Lifestyle	The expression of 'visible' culture that has evolved around a natural resource or ecosystem; describes the extent to which people lead their lives around a natural resource and how people interact with it for recreation (MA 2005, Marshall *et al.* 2016) Survey statement: I value the GBR because it supports a desirable and active way of life
Scientific ~~heritage~~value	The value that people associate with learning opportunities in the past, present and future. The legacy and appreciation of ecosystems and natural resources that have been inherited from the past and their sense of continuity across time (Klain *et al.* 2014, Barbier 2012). ~~It includes past and future learning opportunities.~~ Survey statement: I value the GBR because we can learn about the environment through scientific discoveries
~~**Agency or feelings of personal connection**~~**Wellbeing maintenance**	The ~~capacity of individuals to act independently and to make their own free choices about how they interact with and manage an ecosystem or components of an ecosystem. It includes the extent to which people aspire to environmental stewardship and the responsible use and protection of the natural environment through conservation and sustainable practices.~~The extent to which individuals are concerned for their own wellbeing if the health of the natural resource were to decline (MA 2005). Survey statement: I would be personally affected if the health of the GBR declined

Figure 1. Spider plot showing the importance of eight cultural values provided by the Great Barrier Reef for domestic tourists n=1,522, international tourists n=1,248, local residents n=3,056, indigenous residents n=118, commercial fishers n=210, tourism operators n=117, and national residents n=2002. Note that not all survey questions were relevant to all stakeholder groups. For example, questions about place attachment to the Great Barrier Reef were not presented to tourists domestic or international or Australians national residents.

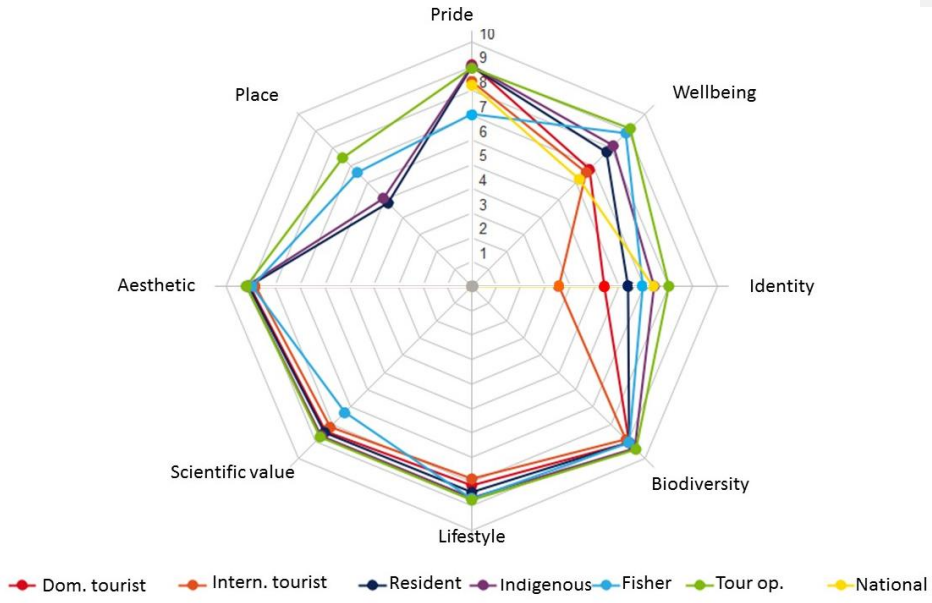

Figure 1. Spider plot showing the importance of eight cultural values provided by the Great Barrier Reef for domestic tourists (dom. tourists) n=1,522, international tourists (int. tourist) n=1,248, local residents n=3,056, indigenous residents n=118, commercial fishers n=210, tourism operators n=117, and national residents n=2002. Note that not all survey questions were relevant to all stakeholder groups. For example, questions about place attachment to the Great Barrier Reef were not presented to tourists domestic or international or Australians national residents.

~~DT=domestictourist;IT=internationaltourist;GL=GBRlocalresident;IL=indigenouslocal;CF=commercialfisher;TO=tourismoperator;A(A)=Australian(notasbumatchFigure1)~~ significant differences are highlighted in red and significant differences are highlighted in yellow. Green indicates that no significant differences were observed.

Figure 2 Pairwise comparisons between stakeholder groups' perceptions of the importance of the reasons for visiting the Great Barrier Reef

Identity	DT	IT	GL	IL	CF	TO	A
DT							
IT							
GL							
IL							
CF							
TO							
A							
Pride							
DT							
IT							
GL							
IL							
CF							
TO							
A							
Wellbeing							
DT							
IT							
GL							
IL							
CF							
TO							
A							
Aesthetic							
DT							-
IT							-
GL							-
IL							-
CF							-
TO							-

Biodiversity	DT	IT	GL	IL	CF	TO
DT						
IT						
GL						
IL						
CF						
TO						
Lifestyle						
DT						
IT						
GL						
IL						
CF						
TO						
Scientific						
DT						
IT						
GL						
IL						
CF						
TO						
Place						
GL	-	-				
IL	-	-				
CF	-	-				
TO	-	-				

DT = domestic tourist, **IT** = international tourist, **GL** = GBR local resident, **IL** =indigenous local, **CF**= commercial fisher, **TO**=tourism operator, A (A)=Australian (font colours match Figure 1.)

highly significant difference p<0.01 significant difference p<0.05 no difference p>0.05

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